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SCIENTIFIC INVESTIGATIONS

Computerized Cognitive Behavioral Therapy for Insomnia in a Community Health Setting

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Study Objectives: Insomnia, though quite common in the general population, is especially prevalent among individuals with co-occurring mental illnesses, patients whose condition can be further exacerbated by insomnia and *vice versa*. For individuals taking one or more psychotropic medications, cognitive behavioral therapy for insomnia (CBT-I), the gold standard in insomnia treatment, is a particularly favorable option (vis-à-vis pharmacotherapy). However, CBT-I can be inaccessible for persons with low socioeconomic status, a group that includes many with psychiatric diagnoses. Computer-based delivery of CBT-I (cb-CBT-I) has the potential to be a cost-effective tool that could greatly improve accessibility for this at-risk demographic.

Methods: Thirty-four participants with insomnia who were currently engaged in mental health care treatment were randomized to an active control group (sleep diary group; n = 16) or cb-CBT-I (n = 18) during weekly outpatient sessions over the course of 6 w. All participants completed sleep and activity logs at each appointment, whereas those in the cb-CBT-I group also completed one session of the cb-CBT-I program each week.

Results: cb-CBT-I treatment was associated with lower scores (improved sleep) on the Pittsburgh Sleep Quality Index (PSQI). *Post hoc* tests demonstrated a between groups difference at week 6 (p = 0.02), with a statistically significant decrease in PSQI scores in the cb-CBT-I group (p = 0.0006) but not in the sleep diary group (p = 0.35).

Conclusions: cb-CBT-I improves sleep in individuals with insomnia and co-occurring mental illness. The significant improvements on the PSQI suggest that implementing a cb-CBT-I treatment in a community mental health center would be a simple and effective treatment for improving sleep over a short period of time.

Commentary: A commentary on this article appears in this issue on page 161.

Keywords: behavioral health integration, CBT, CBT-I, collaborative care, insomnia, technology-assisted care delivery

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INTRODUCTION

Insomnia is one of the most common complaints in primary care and psychiatric settings.[1] Although precise diagnostic criteria vary slightly between sources, insomnia is characterized by a deficiency in the amount or quality of sleep that negatively affects waking activities for more than 1 mo.[2,3] Symptoms of insomnia occur commonly, with up to 50% of the adult population reporting some difficulty sleeping in the past 4 w.[4] The prevalence of clinically diagnosed insomnia is also high, with estimates of insomnia syndromes at approximately 10% of the general adult population[5] and as high as 35% to 45% in adults older than 65 y.[6] The highest rates of insomnia, however, are in persons with co-occurring mental illness, with prevalence estimates ranging from 60% to 90% in some populations.[7,8] The consequences of insomnia are manifold, starting with subjective symptoms such as body pain, emotional distress, poor concentration, and social difficulties,[9,10] and leading to long-term financial and health problems, including increased work absenteeism[11–13] and increased risk for or worsening of comorbidities such as diabetes,[14] depression,[15] and suicide.[16]

Although typical treatment for insomnia involves the use of medication, pharmacotherapy presents risks of side effects and dependency, while offering unclear long-term benefit.[17,18]

BRIEF SUMMARY

Current Knowledge/Study Rationale: The goal of the current study was to explore the feasibility and efficacy of computer-based cognitive-based therapy for insomnia (CBT-I) for patients with comorbid psychiatric diagnoses delivered in a community mental health center setting. Although CBT-I is the gold standard in insomnia treatment, it can be financially and geographically inaccessible for many patients; if shown to be effective, computer-based delivery of CBT-I (cb-CBT-I) has the potential to make treatment accessible for considerably more individuals suffering from insomnia.

Study Impact: The significant improvements in reported sleep suggest that implementing cb-CBT-I treatment in a community mental health center would be a simple, effective, and well-received treatment for improving sleep over a short period of time. These findings further support the current hope that technology-assisted treatments will improve the efficiency and consistency of healthcare delivery.

The risks of pharmacotherapy appear to be heightened with advancing age and the concurrent use of other medications.[19,20] In these instances, efficacy of medication is often limited and medication use contributes to polypharmacy, significant side effects, and morbidity.[21,22] Additionally, several of the most commonly prescribed medications for insomnia have not been shown to be effective in clinical trials.[23] This lack of evidence

is particularly true among persons with chronic mental illness, a population that is often prescribed myriad psychotropic medications to promote sleep.[24] Furthermore, the effectiveness of psychotropic medications in general may be limited in persons with lower socioeconomic status.[25] Hence, persons with chronic mental illness, who are often treated with multiple psychotropic medications and are more likely to have lower socioeconomic status, may stand to suffer the most risk while benefitting the least from psychotropic treatment of insomnia.

In contrast to pharmacotherapeutic approaches to treating insomnia, cognitive behavioral therapy for insomnia (CBT-I) may provide substantial benefit with minimal risk. CBT-I is a treatment approach focused on influencing thoughts and behaviors regarding sleep[22,26,27] that has been found to be effective for clinically diagnosed insomnia and is the gold standard therapy recommended by the American College of Physicians[28] as well as the American Academy of Sleep Medicine.[23] Furthermore, CBT-I is preferred over medication by individuals with insomnia,[29] appears to have more long-lasting benefit than medication,[30] has been shown to be effective in persons with some comorbid illnesses[31] including mental health conditions,[32] and can be combined with pharmacotherapy to promote better outcomes.[22,26] Despite this, CBT-I is often unavailable for many sufferers of insomnia who could derive considerable benefit from it,[27] and is largely unavailable to financially disadvantaged persons suffering from chronic mental illness.

A potential solution to this problem is the relatively recent development of computer software-based delivery of cognitive behavioral therapy. In particular, CBT-I delivered through the Internet has been shown to be effective in treating insomnia in several studies.[33,34] Because such an intervention could potentially provide CBT-I to persons who do not have access to a trained therapist, it is important to determine whether computer-based delivery of CBT-I (cb-CBT-I) could be delivered to patient groups who might not otherwise have access to in-person CBT-I, and whether cb-CBT-I is effective in these populations. However, because many patients with chronic mental illness do not have access to the Internet at home or via a personal device with Internet access, effectively implementing this treatment in this particular population would require a different mode of delivery than that used in previous studies. To explore whether cb- CBT-I could be delivered effectively to this population, we conducted a study providing computer-based CBT-I through weekly appointments at a community mental health center for persons with chronic mental illness and insomnia. We hypothesized that this population could engage in this form of treatment and would benefit from it. Confirmation of our hypothesis would provide preliminary evidence for the utility of this method of improving access to CBT-I, and lay the groundwork for expanding this treatment modality more broadly to patients who may benefit the most from it.

METHODS

Participants

Potential participants were recruited by flyers, online advertisement, and through referral from their mental health care providers. Potential participants were currently engaged in mental health care treatment and self-identified as having difficulty sleeping. Potential participants were screened by research staff and were enrolled if they had an Insomnia Severity Index score of 10 or higher (including subthreshold, moderate, and severe insomnia),[35] were willing and able to make weekly appointments during normal business hours, were English speaking, did not perform less than 2 standard deviations below national means on the Shipley Institute of Living Scale,[36] did not have a change in prescription medication in the past month, and did not meet current criteria for substance use disorders within the past 3 mo. Thirty-four participants provided written informed consent and were enrolled in this Yale Investigational Review Board-approved study (**Figure 1**).

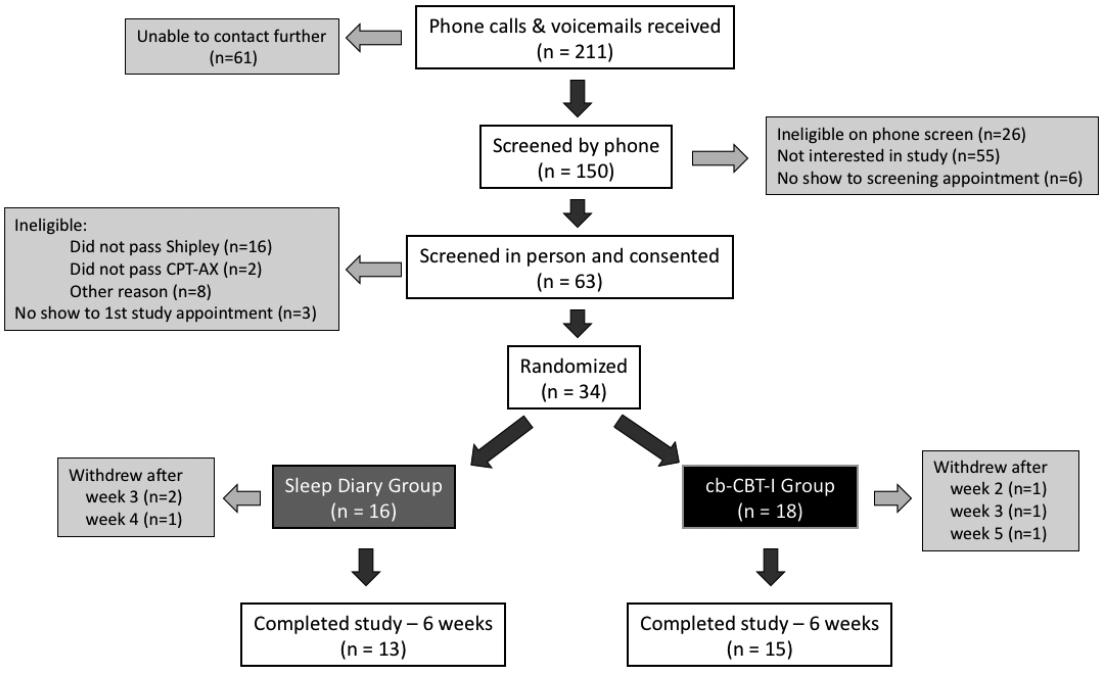
Interventions

Participants were randomized into two groups: the sleep diary group (n = 16) and the computer-based, cognitive behavioral therapy for insomnia group (cb-CBT-I; n = 18). All participants continued to see their regular mental health care providers during the study, and also met weekly with a research associate for six regularly scheduled appointments during normal business hours. At these meetings, participants handed in sleep diaries they were asked to keep and received blank diaries for the next week. In addition, participants in the cb-CBT-I group completed one session using the RESTORE (cb-CBT-I)[33] program at each visit. Participants in both groups were given $10 at each visit as reimbursement for their travel and time spent in research participation.

The RESTORE program consists of six sessions of CBT-I. These sessions include instructional video components as well as interactive elements, and are described in more detail in the supplemental materials. RESTORE is available on Health Insurance Portability and Accountability Act-compliant platforms with a clinician dashboard for patient management and clinical data acquisition and analysis. RESTORE has been shown to be an effective treatment for insomnia in patient populations with mixed comorbidities.[33] Fifteen participants in the cb-CBT-I group (83%) and 13 participants in the sleep diary group (81%) completed all sessions and provided useable outcomes data.

To deliver the RESTORE treatment program, a large-screen computer workstation was set up with high-quality headphones and reliable Internet access in a private office space at the community mental health center. A user account for clients was created on the workstation to allow access to the RESTORE website only, using standard operating system and Internet browser functions to limit other access. At each scheduled visit, participants presented themselves to the office of a research associate. Those who received cb-CBT-I were subsequently brought to the space with the workstation. Participants who received cb-CBT-I were instructed in how to access their personal accounts on the cb-CBT-I website. At each visit, the research associate confirmed that the participant was able to access the website and begin the session before leaving for a nearby space where the associate remained accessible. At the end of the study, participants in the cb-CBT-I group rated how understandable they found the

Figure 1—Recruitment and participation flowchart.



cb-CBT-I to be, how much of the information they applied, and how useful they thought the information was on a visual analog scale of 0 to 100 points.

At the beginning of the first weekly visit, and again at the sixth visit, all participants completed the Pittsburgh Sleep Quality Index (PSQI). The PSQI is a questionnaire that rates sleep on seven subscores using qualitative and quantitative measures: overall quality of sleep, initial falling asleep, total amount of sleep, sleep efficiency, sleep disturbances, use of sleep medication, and effect on waking life. These scores are added to generate an overall score. Participants also repeated the Insomnia Severity Index (ISI, completed initially at screening) during the sixth session.

Analysis

Possible between group differences in age, sex, number of years of education, estimated Intelligence Quotient, ISI (at screening), use of medications, and diagnoses were assessed with unpaired *t*-tests or Fisher exact test as appropriate. PSQI (primary outcome) and ISI (secondary outcome) were assessed by two-factor analysis of variance with repeated measures on one factor, with group (cb-CBT-I versus sleep diary) as the between-subject factor and time (screening/week 1 versus week 6) as the repeated-measures factor, using data from all completers. *Post hoc* comparisons were completed as appropriate. In addition, in exploratory, *post hoc* analysis, each PSQI subscore was compared between week 1 and week 6 using paired *t*-tests, and frequency of participants who achieved 'subthreshold' insomnia on the ISI (less than 15)[35] at week 6 were compared with the Fisher exact test. Sleep diary entries including time spent napping during the day, time into bed, latency to sleep, number of awakenings, time out of bed, and sleep quality (on a 0 = very good to 4 = very poor Likert-type scale) were averaged from entries during week 1, and similarly with week 6 data. Day-to-day variability in time to bed and time out of bed was also determined for each participant at week 1 and week 6. Changes in sleep diary measures from week 1 to week 6 were assessed with paired *t*-tests. Alpha was set at 0.05 for all tests and all tests were two-tailed.

RESULTS

Living situation and work status for all participants are shown in **Figure 2**. The majority of participants did not reside in their own home, but rather resided with friends or family, in a single room occupancy facility, in a shelter, in an inpatient unit or with a community agency. Relatively few participants were formally employed; a large proportion was on disability, whereas a similar number was seeking work. A high school education was the most common education level achieved (29%), with somewhat fewer participants reporting completion of 2 y (24%) or 4 y (24%) of college.

Participants in the cb-CBT-I group were well matched to those in the sleep diary group with regard to age, sex, estimated Intelligence Quotient, education level, use of medication, and known diagnoses (**Table 1**). Diagnoses were taken from participants' clinical treatment records. There were no statistically significant differences between groups in these measures. Visual analog scale ratings of the understandability of the intervention, whether participants applied what they learned, and how useful the intervention was found to be are shown in **Figure 3**.

There was no main between-group effect for PSQI ($F_{1,26} = 0.6$, $p = 0.44$), but there was a significant within-subjects effect of time ($F_{1,26} = 18.8$, $p = 0.0002$), as well as a significant group by

Figure 2—Living situation (left) and employment status (right) of participants.

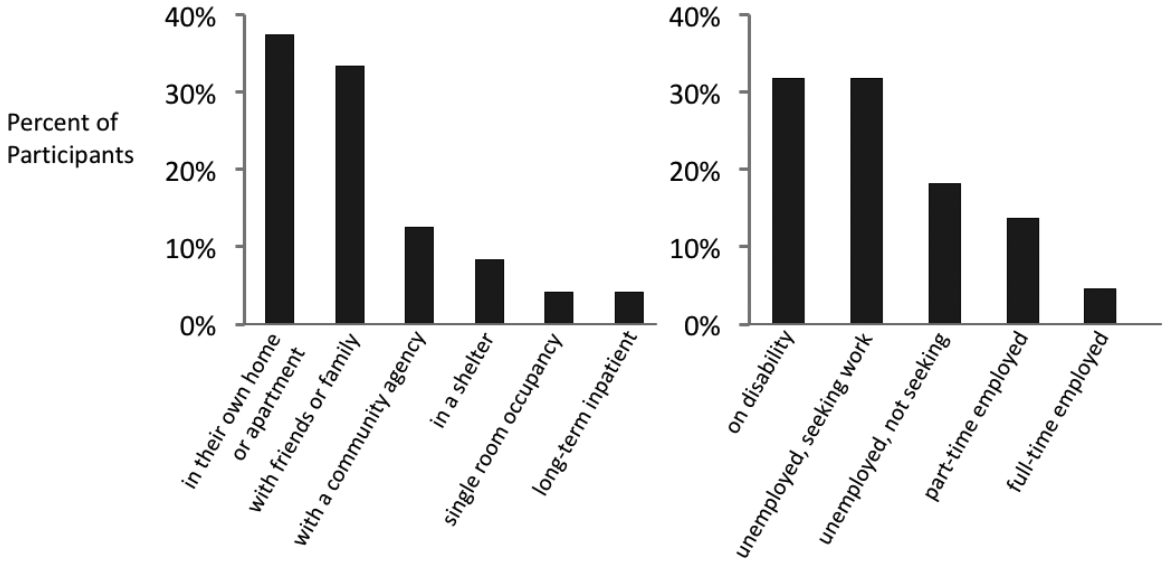


Table 1—Participant characteristics.

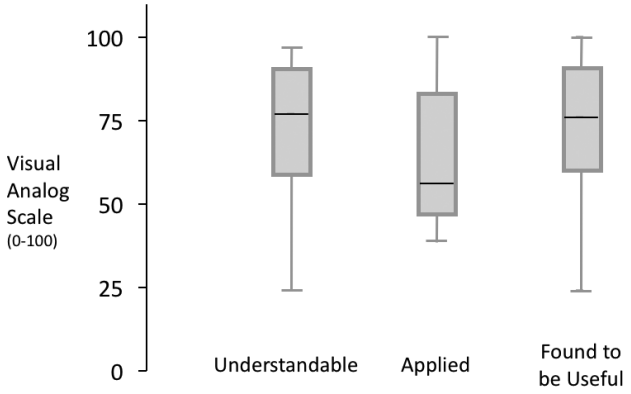
	Sleep Diary (n = 18)	cb-CBT-I (n = 16)	p
Age (y)	50 ± 10**	48 ± 10	0.6
F:M	10:8	9:7	> 0.9
Education (y)	13 ± 1	14 ± 2	0.2
IQ estimate	93 ± 11	94 ± 9	0.8
Insomnia Severity Index	22 ± 5	21 ± 4	0.5
Completers (n)	15	13	> 0.9
Medication use (n)	17	15	> 0.9
Antidepressant	9	8	> 0.9
Antipsychotic	11	10	> 0.9
Mood stabilizer	6	7	0.7
Benzodiazepine/Benzodiazepine-like	4	5	0.5
Antihistamine	1	2	0.6
Other psychiatric	4	6	0.5
Other nonpsychiatric	5	6	0.7
> 1 sleep promoting medication	9	10	0.5
Diagnosis (n)*			
Major depression	9	7	0.7
Bipolar	6	3	0.4
Schizophrenia	1	1	> 0.9
Schizoaffective	4	1	0.3
Anxiety disorders (excluding PTSD)	5	6	0.7
OCD	0	1	0.5
Personality disorder	0	2	0.2
Psychosis	1	1	> 0.9
Polysubstance use	1	0	> 0.9
PTSD	3	3	> 0.9
Mood disorder NOS	1	1	> 0.9
Unknown	0	4	0.04

*17 participants had 2 or more diagnoses, reflected above. **Error values are standard deviations. cb-CBT-I = computer-based delivery of CBT-I, NOS = not otherwise specified, OCD = obsessive-compulsive disorder, PTSD = posttraumatic stress disorder.

time interaction ($F_{1,26}$ = 10.5, p = 0.003). *Post hoc* tests showed a between-groups difference at week 6 (10 ± 5 [standard deviation] vs. 13 ± 5, p = 0.02, Cohen d = 0.72, **Figure 4**), with lower (better) PSQI scores in the cb-CBT-I group, reflecting a statistically significant decrease in PSQI scores in the cb-CBT-I group (p = 0.0006), but not in the sleep diary group (p = 0.35). Fifty-three percent of participants in the cb-CBT-I group and none of the participants in the sleep diary group had improvements in their PSQI score of three points or more (i.e. treatment response; Fisher exact test, p = 0.0025), and two and zero participants, respectively, had final PSQI scores of less than five points (good sleep quality).

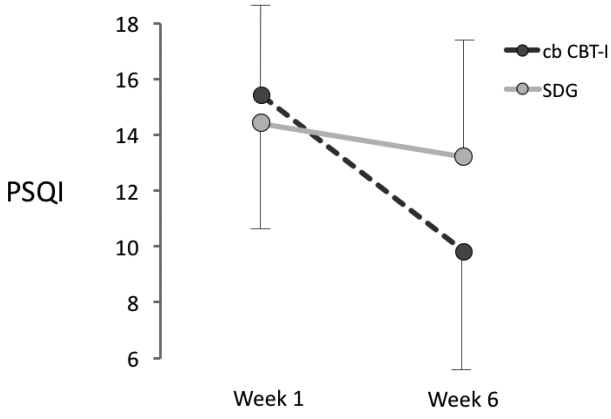
Among the PSQI subscores, overall sleep quality, initial falling asleep, total amount of sleep, and the use of sleep medication all showed statistically significant improvement in the cb-CBT-I group (**Figure 5**). None of the seven subscores showed improvement in the treatment as usual group. Among sleep diary measures, there were no changes in the sleep diary group. However, in the cb-CBT-I group the number of nocturnal awakenings (per night) decreased by 24% (2.0 ± 1.1 to 1.5 ± 0.9; p = 0.01), sleep quality improved by 22% (2.3 ± 0.5 to 1.8 ± 0.8; p = 0.04), and time spent napping decreased by 69% (19 ± 20 to 6 ± 8 min; p = 0.03). Additionally, only in the cb-CBT-I group there was a trend decrease in the day-to-day variability in the time at which participants got out of bed in the morning (the mean of the standard deviations for each

Figure 3—Participants who received computer-based cognitive behavioral therapy for insomnia rated how understandable the videos were, how much of the information in the videos they applied, and how much of the information was found to be useful.



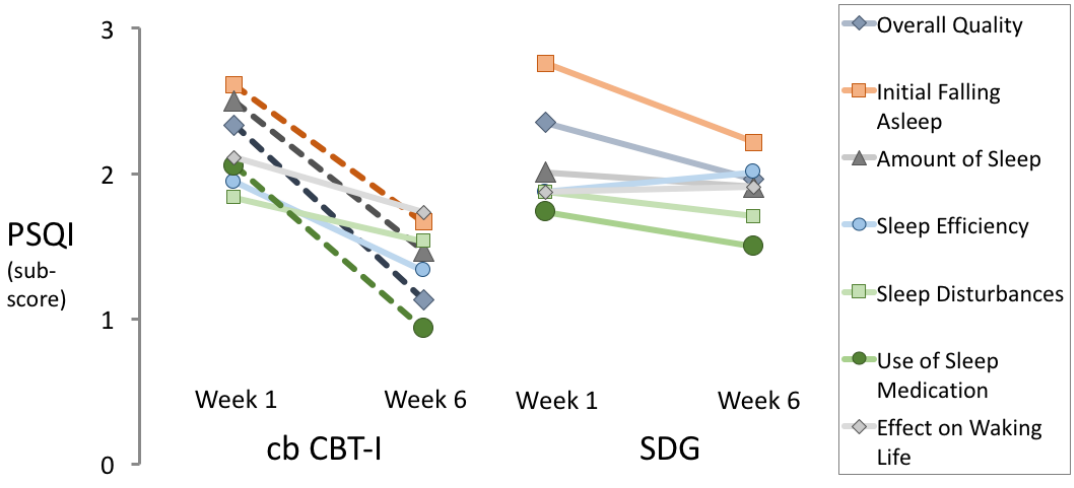
Boxes indicate interquartile range around the median, whiskers indicate range.

Figure 4—Study participation was associated with a decrease (improvement) in PSQI from week 1 to week 6 (p = 0.0002) and a treatment group by time interaction (p = 0.003).



Post hoc analysis revealed a significant improvement in Pittsburgh Sleep Quality Index (PSQI) in the computer-based cognitive behavioral therapy for insomnia group (p = 0.0006) and a between-groups difference in PSQI at week 6 (p = 0.02). Error bars are standard deviation. SDG = sleep diary group.

Figure 5—Pittsburgh Sleep Quality Index subscores declined uniformly in the computer-based cognitive behavioral therapy for insomnia group, with significant improvements in four of seven parameters.



Heavy dashed lines = overall quality ($p < 10^5$), initial falling asleep (p = 0.004), amount of sleep (p = 0.004), use of sleep medication (p = 0.01). There were no significant changes in the sleep diary group.

individual's out of bed times decreased by 36% from week 1 to week 6 (from 1 h, 33 min to 1 h, 1 min; p = 0.06). The day-to-day variability in bedtime decreased similarly (by 38%) in the cb-CBT-I group but that decrease was not statistically significant (p = 0.13).

There was no between-group effect for ISI ($F_{1,26}$ = 2.29, p = 0.14), but there was a significant within-subjects effect of time ($F_{1,26}$ = 33.4, p < 0.0001) and a significant group by time interaction ($F_{1,26}$ = 15.3, p = 0.0006). Mean ISI decreased from 22 ± 4 to 13 ± 6 in the cb-CBT-I group (p < 0.0001; Cohen d = 1.8) but was unchanged from 21 ± 4 to 19 ± 6 in the sleep diary group (p = 0.1; Cohen d = 0.28). Also, week 6 scores were significantly lower in the cb-CBT-I group compared to the sleep diary group (p = 0.009; Cohen d = 1.1). Sixty percent of participants in the cb-CBT-I group and 23% of participants in the sleep diary group had ISI scores of 14 or less at week 6 (Fisher exact test for between group difference, p ≈ 0.05). In addition, 53% of participants in the cb-CBT-I group and none of the participants in the sleep diary group had improvements in their ISI score of eight points or more (treatment response; Fisher exact test, p = 0.0025), and one and zero participants, respectively, had final ISI scores of less than 8 (no insomnia).

DISCUSSION

The current study aimed to explore the following questions related to technology-enabled CBT-I: Is the use of cb-CBT-I that is accessible in a community mental health center effective and feasible? Will individuals understand and employ knowledge supplied by software-based CBT-I provided in a community mental health center? Will the clinical effect of the system be meaningful? Answering these questions with regard to CBT-I is particularly important given the exceedingly high rate of insomnia in persons with chronic mental illnesses and the extremely limited access to trained therapists who can deliver in-person CBT-I in this population.

Although this study was run in parallel with normal clinical care, it was conducted in a community mental health center using a standard clinical workflow model, with participants referred by their primary mental health clinicians or responding to flyers placed in the building. Setting up the office space with the computer, Internet access, and headphones required only a basic, working knowledge of these technologies, and the Internet access available in the center was fully adequate to deliver the cb-CBT-I without problems. The research staff who met with participants and facilitated the delivery of care were bachelor's degree level staff without professional credentials. Although a private office space was used with only one participant at a time, access to high-quality headphones could allow multiple workstations in the same room, perhaps separated by partitions, and more than one person receiving treatment concurrently. Overall, the implementation of this type of therapy in this setting was simple, with a small space requirement, minimal investment in hardware, and minimal training required for staff already experienced with interacting with consumers in a clinical setting. It is worth noting that all participants in the study were regular attendees at the community mental health center where this study was run, so did not likely face substantial barriers with regard to motivation or ability to come regularly to the center. Implementation of this treatment at a community mental health center to a broader audience (persons who are not already clients at the health center) would face additional challenges not addressed in this work.

In addition to being easily implemented in the clinic setting, the technology-aided therapy appeared to be well received by the participants, with generally positive responses to the computer-based therapy (in terms of understandability and applicability) and an excellent completion rate (although the small reimbursement offered for participation likely influenced this). Although previous studies included those suffering from comorbidities such as PTSD, major depressive disorder, anxiety disorders, and substance use disorders,[33] there has not been an analysis of whether those in lower socioeconomic cohorts such as those seen in a community health clinic setting would benefit. In the current study, less than half of participants lived independently, and a not insignificant portion of the cohort was living in homeless shelters, single room occupancy settings, or in a setting run by a community agency. Consistent with the circumstances of their living arrangements, only a small number of participants were employed full- or part-time. The population studied held relatively few advanced degrees (3% in current sample, compared to 12% in the United States in general), despite high school and college education rates being comparable to the national average. This difference may be related to the onset of many mental illnesses in early adulthood.[37]

Despite the sociodemographic challenges and chronic mental illness in this cohort, the cb-CBT-I had a strikingly beneficial effect on sleep compared to active control as reflected in a well-validated and broad measure of sleep quality (PSQI),[38] a simpler and subjective self-report measure (ISI),[39] and sleep diary data. The decreases in PSQI and ISI with treatment were both statistically significant and clinically meaningful, with the mean ISI score decreasing from "severe" clinical insomnia (i.e. a score of 22+) to "subthreshold" insomnia (i.e. a score of 8–14, per ISI interpretation guidelines[39]). In addition to a large decrease in the global PSQI score (36%), participants noted significant improvements in overall quality of sleep, time to fall asleep, and sleep quantity. Sleep diary data further suggest that tighter regulation of the sleep-wake schedule, decreased napping, and fewer awakenings may contribute to improved sleep quality from cb-CBT-I treatment. The decrease in the use of medications to promote sleep (from the PSQI) from on average "once or twice a week" to "less than once a week is particularly noteworthy as it could lead to a decreased risk of medication-related adverse events (and more general complications from polypharmacy), and may therefore reduce health care costs both directly and indirectly.

Although encouraging, these results should be considered in the context of several limitations, including the relatively small size of the sample, the possibility of placebo effects related to participating in the cb-CBT-I, the lack of purely objective measures of sleep such as polysomnographic sleep recording, and the short duration of the study and lack of long-term follow-up data. Although the sample size was modest for a clinical study, these results represent only preliminary data supporting this

finding. Nevertheless, the groups were well balanced and the statistical findings were strong and consistent across two measures of sleep quality. The small sample size also precluded a meaningful analysis of whether there was any relationship between participants' ability to understand and apply the information in the cb-CBT-I and their response to it. However, even if such a relationship were to be found, it would not confirm the absence of a placebo effect from the computer-based therapy, as the apparent ability to understand the material and a belief that the material was applied may be erroneously reported by those who believe they have benefited from participating in the treatment (whether they had or not). Similarly, although traditionally delivered CBT-I has been shown to be effective and to have positive effects on the polysomnographic measurement of sleep,[40] the possibility remains that effects of demand characteristics on the self-reported measures used in this study positively influenced outcomes.

A particular challenge with designing a study like this one is appropriately handling the control group. In this study, the only difference between the two groups was that the cb-CBT-I group watched an online cb-CBT-I module during the weekly appointments whereas the sleep diary group did not. Although this design attempted to minimize the differences in the experience of participants in each group outside of the cb-CBT-I itself, participants in the active treatment group spent somewhat longer at the appointments than those in the sleep diary group because of the time spent watching the modules. However, there was little difference in the amount of time spent interacting with staff. Because both groups were already engaged in regular mental health treatment, the frequency or quality of which was not changed by participation in this study, the addition of a more 'active' control intervention was deemed unnecessary.

Because participants in this study were not clients of a sleep clinic, but rather, clients of a mental health clinic, they had not been assessed by a sleep specialist as part of the study. Prior to inclusion in the study, potential participants were assessed by research staff experienced in sleep disorders. Although clients participated in a survey assessing sleep health, they were not evaluated by a sleep specialist. If an individual was found to have a sleep disorder via interview or prior diagnosis in the medical record, they were excluded from the study. Our subject population as a whole consisted of individuals with relatively low access to care, which does leave open the possibility of undiagnosed sleep disorders.

Despite these limitations, this study suggests that implementing this type of treatment in a community mental health center would be relatively simple, largely well received by its consumers, and possibly very effective in improving sleep over a short period of time. These findings are increasingly relevant as interest in engaging health care consumers with technology, as reflected in the literature and the popular media, points to the hope that the assistance of technology will make delivery of effective health care more efficient and consistent. Future studies should address potential long-term benefits of these interventions by collecting data about other outcome measures including mental health symptoms and quality of life, and should also include purely objective measures such as polysomnography. In addition, the acceptance of this intervention more generally in this population should be gauged, as the current study did not attempt to "prescribe" this intervention broadly but sought volunteers who were aware of the intervention. Also, vitally important is the assessment of possible predictors of success (attitude toward behavioral interventions, attitude toward computer-based therapies, current cognitive and mental health status, current engagement in treatment, current level of treatment, history of prior treatment, etc.),[34] as well as more comprehensive studies of the possible benefits of this intervention on use of medication as well as comorbid psychiatric and physical health symptoms. To do so, a longer (and larger) study designed to assess changes in prescribing, as well as broader assessments of clinical status and symptomatology, would be beneficial.

ABBREVIATIONS

CBT-I, cognitive behavioral therapy for insomnia
cb-CBT-I, computer based cognitive behavioral therapy for insomnia
ISI, Insomnia Severity Index
OCD, obsessive compulsive disorder
PTSD, posttraumatic stress disorder
PSQI, Pittsburgh Sleep Quality Index
SDG, sleep diary group

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